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D. Physical State of the Soils

1. Permafrost in the usual sense, where frozen soils are cemented together with ice and represent a solid monolith which is very difficult to work mechanically.

2. Dry permafrost, where porous permafrost soils have not been cemented by ice because of their very low humidity, and can be worked mechanically in the same way as thawed soils.

3. Soft permafrost, where the soils have sufficient humidity and below-zero temperature, but are not cemented by ice, and differ little from thawed soils in external appearance and properties.

However, the above classification of permafrost, although generally accepted at this time, does not exhaust even its basic properties. Specifically, the classification completely fails to describe the construction properties of permafrost, although it makes certain indirect references to them. No engineer can draw conclusions on permafrost soils as future construction foundations by using only the characteristics given in the above classification.

First of all, an engineer must ask himself what changes may take place in permafrost soils while construction is progressing. The choice of a construction principle for permafrost depends first on whether or not the permafrost will remain under the building. Without going into the structural and technological characteristics of the building, which are also very important in selecting the construction principle, it can be said that there is a basic relation between these principles and the general nature of the permafrost. If one can rightly assume that the soil will be maintained in its frozen state after completion of the building, then one naturally selects a construction principle which rests upon preservation of permafrost (principle A in OST 90032-39); if this cannot be assumed, a principle is selected which admits of possible thawing of the permafrost foundation (principle B from the same OST).

In practice, the problem is of course much more complex and the construction principle selected depends upon a whole set of conditions (geological, hydrogeological, climatic, and ice characteristics of the section; the type of building area; the temperature conditions of the building, its design, etc.). However, there is a general dependence between permafrost stability and the basic construction principles adopted, which are even taken into consideration in norms. For example, Paragraph 32 of Technical Specifications (3) states that "in the construction of buildings which will give much heat to the soil and also in the event that the permafrost is unstable, the construction as a rule should proceed according to the principle which assumes thawing of permafrost."

Thus we have a permafrost characteristic not considered by the present classification, namely, the construction characteristic. Despite the controversial nature of the problem, this terminology has already begun to be accepted by engineers and appears in specialized literature; for example, N. A. Tsytovich (8) characterizes permafrost as unstable at a below-zero temperature of -0.1 to -0.2°C in the presence of active ground waters; N. I. Bykov and P. N. Kapterev (1) consider permafrost reliable if its depth is at least 25 meters and if the temperature at a depth of 10 meters is not higher than -1°C . A. V. Liverovskiy and K. D. Morozov (2), in citing the conditions necessary for construction according to the principle of preservation of permafrost, include stability in these conditions. According to Technical Specifications for Surveys, Layout, and Construction of Railroads in the Permafrost Regions (7), permafrost is considered unstable if its depth is less than 20 meters and if it has insular or bedded enclosures and a temperature of -1.0°C at a depth of 6 meters. Finally, N. I. Saltykov (4) understands permafrost "stability" to be its ability to withstand certain changes of external conditions and to be reestablished if these conditions are temporary.

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The above references indicate how important permafrost characteristics are from the standpoint of evaluating stability in construction, and therefore the terminology "stable" and "unstable" permafrost must be fully accepted.

Regarding a quantitative evaluation of permafrost stability, N. I. Saltykov proposes to define it by the magnitude of the temperature gradient, which includes not only temperature, but also its vertical distribution.

This terminology is gradually being accepted by permafrost engineers and must soon become official. Quantitative evaluation of permafrost stability characteristics has not yet been established; its development will be difficult but necessary since this is one of the priority problems of engineering permafrost studies.

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